March 17, 1887.

Professor STOKES, D.C.L., President, in the Chair.

The Presents received were laid on the table, and thanks ordered for them.

The following Papers were read:—

I. "A Coal-dust Explosion." By W. GALLOWAY. Communicated by R. H. SCOTT, M.A., F.R.S. Received February 17, 1887.

(Abstract.)

The Silkstone pits of Altoft's Colliery, near Normanton, in Yorkshire, in which the explosion took place, are 420 yards deep. Both shafts are round, the down-cast being 12 feet and the up-cast 10 feet in diameter. The thickness of the working, including a bed of soft shale below the seam, used as a holing, is 4 feet 6 inches. The system of working is longwall. The number of men and boys employed underground in the day shift was about 350. The colliery is now twenty-one years old.

Very little fire-damp is produced in the workings. Naked lights were used by all the workmen for twenty years before February, 1886, yet during the whole of that period no single workman had been injured by an explosion of fire-damp, great or small.

Besides being naturally very free from fire-damp, the workings of this mine were continuously swept by strong and swift currents of air, produced by means of two ventilating furnaces at the bottom of the up-cast shaft, amounting in the aggregate to 147,380 cubic feet per minute.

As the roof subsides upon the stowing near the faces, it is necessary to take down a certain thickness of it in the stall roadways, in order to preserve them at a workable height. For this purpose about 4 feet in thickness of roof was taken down by blasting in each stall road, the height being thus made about 8 feet 6 inches, at a distance of 10 or 12 feet back from the face. Each stall road thus required about one blasting-shot, with a charge of from two to three pounds of powder to be fired in it about once every five or six days, so that from seven to ten blasting-shots were fired near the faces every day. In this way the floor of each roadway became covered with small

pieces of broken roof, which completely obscured any small quantity of coal or coal-dust that might have fallen upon it, and been left there in the process of coal-getting.

The tubs consist of rectangular wooden boxes, mounted on wooden frames, with wheels attached to them. They were filled with coal to a level with the top, and then contained about 10 cwt. Thus, although no coal could fall over the ends or sides, the vibration due to the operation of hauling caused coal-dust and small pieces of coal to be shaken out through the seams in the sides and bottom on to the roadway beneath. Here it accumulated little by little between the rails, and to a distance of a few inches on each side of them, and the attrition due to the constant trampling of men and horses, together with the occasional dragging of the endless chains on the floor, gradually reduced it to a state of fineness. The quantity of coal-dust which accumulated on any roadway was thus, other things being equal, proportional to the number of full tubs that had passed along it from the first; so that the oldest roadways would naturally be the dustiest, were the accumulations not removed from time to time.

Each return air-way represents the continuation of a stall road all the way from near the bottom of the up-cast shaft to the face, and it must therefore contain in any given section of its length about the same average quantity of coal-dust as any ordinary stall road. But the return air-ways are all used as travelling roads for the men and boys going to and from the faces, and the constant trampling of feet soon mixes up any little coal-dust there may happen to be on the floor with the dust of the roof-stuff, and reduces the whole to an impalpable powder of a light grey colour.

The following conditions thus prevailed before the explosion:—

1. An unusual immunity from fire-damp.

2. Very excellent ventilation.

3. Blasting going on at the rate of say 2000 shots a year, involving the consumption of upwards of two tons of powder in the same time, and this within the zone of subsidence where, practically speaking, all the fire-damp was given off, and where there was no coal-dust.

4. Pure air filling the intake air-ways from the bottom of the down-cast to the faces.

5. Air containing all the fire-damp in the colliery filling the working places and the return air-ways from the faces to the up-cast.

6. Coal-dust in the intake air-ways decreasing rapidly near the faces.

7. Light grey dust of roof-stone, but no visible coal-dust in the return air-ways.

The colliery had been carried on under these conditions for seven-

teen years within the experience of the present manager. During the whole of that time no blasting had ever been done in any intake air-way. On the 2nd of October last, however, a party of men were instructed to blast away a portion of the side of the west chain road at a distance of about 550 yards from the bottom of the shaft. They fired three shots in all, and the third caused the explosion. It was not a blown-out shot in any sense.

The mechanical effects were exactly the same as those produced by other explosions. Timber was torn out, and falls of roof sometimes of great magnitude and extent were caused all through the intake air-ways, as far as the flame reached. In the endless chain roads the box part of each empty tub was swept away from the frame, and shattered into small pieces, not one being left whole. A spare pulley-wheel, 4 feet in diameter and weighing 15 cwt., which had been standing on its edge leaning against the side near the end of the west chain road, was carried four yards inwards towards the face, and laid flat on its side.

The flame traversed all the intake air-ways, except the new east road, and died out in some nearer to, and in others further from, the faces. It did not in any case pass into a return air-way. It did not reach the face of the workings at any point.

The new east road was quite undisturbed. Two men who were working in it felt a concussion of the air, but saw no flame, and came out unscathed. This result appears to be due entirely to the circumstance that the principal stables were ranged along the entrance to this road, and the ground having been kept constantly wet with the water used in the service of the horses, the flame was unable to pass that point for want of coal-dust to sustain it.

II. "Second Note on the Geometrical Construction of the Cell of the Honey Bee ('Roy. Soc. Proc.,' vol. 39, p. 253, and vol. 41, p. 442)." By Professor H. HENNESSY, F.R.S. Received February 21, 1887.

If from the intersections of the diagonals of the three lozenges forming the apex of the cell, perpendiculars be erected, these will meet at a point on the cell's axis, and each of them is manifestly the radius of a sphere tangent to the three lozenges. A plane passing through a radius and the axis passes through the short diagonal, e, of the lozenge whose length is $h\sqrt{(3/2)}$; using the notation and results of the paper above cited.

The distance intercepted on the axis by a perpendicular let fall from the middle of the lozenge is equal to $x = h/(2\sqrt{2})$, and as this